Estimated Takes of Protected Species in the Commercial Directed Shark Bottom Longline Fishery 2003, 2004, and 2005.

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This report estimates total takes of protected species in the U.S. Atlantic commercial directed shark bottom longline fishery for the years 2003, 2004, and 2005. For the purposes of this report, takes of protected species (hereafter "takes") refers to protected species that were incidentally captured during fishing operations. Although the shark bottom longline fishery comprises fishers that hold directed and incidental shark permits[1], only the commercial directed portion was considered in this report. For consistency with prior estimates made in a 2003 Biological Opinion[1], I attempted to follow the same methods, but this was not always possible. Both directed and incidental permit holders report their activities to the fishery logbook system at the Southeast Fisheries Science Center (SEFSC) without reference to the permit type they are operating under, making it necessary to allocate effort to the directed portion of the fishery using an approximation based on the Southeast Regional Offices (SERO) permit database. Estimates of total takes in this report were based upon self reported effort from both the SEFSC coastal and pelagic longline fishery logbook programs (adjusted by the approximation of vessels associated with those fishers that held active shark directed permits), and observed catch and effort from an observer program that attempted to randomly select vessels for observation from those that held directed shark permits. This observer program was first conducted by the Commercial Shark Fishery Observer Program, Florida Museum of Natural History, University of Florida (Burgess and Morgan, 2003) until the middle of 2005, when the program was then administered by the National Marine Fisheries Service (NMFS), Southeast Fisheries Science Center, Panama City Laboratory (Smith et al. 2006).

Methods

Observed takes for the commercial directed shark bottom longline fishery came from two sources: the University of Florida (UF) observer program from 2003 through the first season of 2005, and the SEFSC observer program database for the second season of 2005. In this analysis, season 1 was defined as January through June, and season 2 as July through December (although observed fishing may have been episodic within those time frames). This definition of season was consistent with estimates of takes prior to 2003[1], and the UF observer database. The SEFSC observer program uses trimesters (Smith et al. 2006) to match management, which for this analysis were converted to the two season system for consistency.

This fishery was observed in two general regions, the "South Atlantic" (SA) region (defined in Smith et al. 2006 as the eastern U.S. coast from North Carolina to the Florida Keys [not the South Atlantic Ocean]), and the Gulf of Mexico (GOM) region (along the coast from Texas to South Florida). The UF observer program database used these 2 regions in 2005, but had divided the SA into two regions during the years 2003 and 2004. These regions were combined and classified as SA for this report. There was an area of overlap between the definitions of regions SA and GOM in four of the statistical areas

[1] Biological Opinion on the continued operation of Atlantic shark fisheries (commercial shark bottom longline and drift gillnet fisheries and recreational shark fisheries) under the Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks (HMS FMP) and the Proposed Rule for Draft Amendment 1 to the HMS FMP, July 2003.

used in the coastal logbook. This overlap region is east of 83° W longitude and south of 25° N to west of 81° W longitude and north of 24° N latitude. For records within this area of overlap I accepted the classification by statistical areas recorded in the coastal logbook database. The pelagic longline logbook data does not classify by region but provides specific latitude and longitude for each set. For simplicity, I defined all sets from the pelagic longline logbook that fell within the statistical area overlap from the coastal logbook as belonging to the SA region. I accepted the classification by region made by the SEFSC observer program and the UF program (with the combined SA).

The observer programs tracked takes by region and by season which could be justified for several reasons: (1.) The two regions differed in common fishing practices (Smith et al. 2006) including hook size, which has been shown to have a significant effect on sea turtle capture in another longline fishery (Watson et al. 2004); (2.) It seems reasonable to expect the protected species caught in this fishery to differ in their abundances and distributions between regions and seasons; and (3.) For tracking the management of the fishery. However, for 2005 I found no significant effect of region (logistic regression, N =134, $df = 1$, Wald $\chi^2 = 0.0012$, $P = 0.9728$), season (logistic regression, N =134, $df = 1$, Wald $\chi^2 = 0.0009$, $P = 0.9757$), or their interaction (logistic regression, N =134, $df = 1$, Wald $\chi^2 = 0.0012$, $P = 0.9727$), on observed takes of protected species. Extremely sparse data were the main impediment to evaluating the utility of any stratification. Therefore, although pooling the data across stratifications of season and region might be justified to reduce the sparseness of the data, such pooling may not be appropriate because it would ignore the fore-mentioned non-random distribution of the species incidentally captured, and the differential operation of the fishery between areas. In this report I present both annual pooled and fully stratified estimates (with annual sums), for illustrative purposes.

To determine participation in the shark bottom longline fishery from the trip based coastal logbook program, I first assumed that if sharks were landed and the fishers reported using bottom longline gear, the fishers were in possession of a directed or an incidental shark permit. Thus all sets for that trip were initially counted toward total effort of the shark bottom longline fishery. For the set based pelagic longline logbook, I selected bottom longline sets that targeted sharks, again assuming that those fishers were in possession of a directed or an incidental shark permit. To limit this estimate of effort to fishers that held directed shark permits, I then acquired a list of all vessels from the SERO permit database that had a directed shark permit associated with it for at least a portion of a given season and year. Any vessel not in this list was excluded from the effort estimation for that particular season and year. This was an approximation because one cannot efficiently determine the exact the period of time a vessel held a valid directed shark permit. Instead it was assumed that if a vessel had a directed shark permit for at least a portion of any given season and year, it was likely that the person associated with that directed permit only landed sharks during periods for which their permit was valid. Therefore part of this assumption, that fisheries that held directed shark permits did not land sharks outside of the open shark season, could potentially cause an inflation of the estimate of effort if its not true.

Estimation of the total fishery effort for extrapolation from the observed takes to total estimated takes was constrained by the information consistently and reliably reported in common between the two sources of logbook data, and the two sequential sources of observation data. For this analysis I used two measures of effort, set and number of hooks in a set. A combination of the binomial model and the effort variables set and hooks was used for estimation of takes for years prior to 2003[1]. The use of hooks as an effort variable (and thus the use of the delta lognormal model, as opposed to the binomial model applied to sets) was due in part to the use of this effort parameter and analysis type in a similar fishery, the pelagic longline (see Johnson et al. 1999, Walsh and Garrison 2005). Number of hooks per set was not significantly related to observed takes of protected species in 2005 (logistic regression, N=134, Wald $\chi^2 = 0.1058$, $P = 0.7450$) thus there was no statistical justification for using hook rather than set.

The standard binomial model was used to estimate probability and the coefficient of variation (CV) of capture per set. The 95% confidence intervals were estimated using the "Wilson" interval, which has been shown to have a reasonable coverage particularly for extreme probabilities (see Brown et al. 2001). It should be noted, however, that the estimation of confidence intervals for the binomial are fraught with problems, especially for sparse data sets (see Brown et al 2001, and subsequent arguments).

A delta lognormal approach (Pennington 1983) was used to estimate the mean and variance of takes per hook per set. This method combines a binomial model for the total observations with a lognormal model for the non-zero catch per unit effort (CPUE) data, which are assumed to be lognormally distributed. Extrapolated takes by the fishery was the multiplication of either catch per hook or probability of catch per set by the appropriate units of total effort (hook or set) extracted from the logbooks.

Estimation of total takes could be done for several levels of stratification: By year, season, region, release condition, and classified by either hook or by set. Because the final estimate of total takes could be sensitive to analysis method or different levels of data stratification or pooling, I estimated extrapolated takes of each species several ways for comparison: classifying effort by hook or by set, and stratifying the analysis by year, region, and season, or analyzing the annual data pooled across region and season. When information was available, I further stratified the data by release condition of the species (alive or dead), in addition to pooled release condition to estimate total takes. Annual sums of stratified estimates were also calculated wherever possible.

Results and Discussion

There were a total of 25 observed takes of all protected species from 2003 to 2005, which included 1 bottlenose dolphin (*Tursiops truncatus*), 3 smalltooth sawfish (*Pristis pectinata*), 2 leatherback sea turtles (*Dermochelys coriacea*), 17 loggerhead turtles

[1] Biological Opinion on the continued operation of Atlantic shark fisheries (commercial shark bottom longline and drift gillnet fisheries and recreational shark fisheries) under the Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks (HMS FMP) and the Proposed Rule for Draft Amendment 1 to the HMS FMP, July 2003.

(*Caretta caretta*), 1 unidentified sea turtle, and 1 unidentified turtle (assumed to be a sea turtle for this report), (Table 1 and Figures 1-3). All three captured sawfish were released alive, the single bottlenose dolphin was dead, one of the two leatherbacks was dead, and 6 of the 17 loggerheads were dead.

Total fishery effort is summarized in Table 2 and observed effort is summarized in Table 3. These tables, together with the table of observed takes (Table 1) provide all information needed to produce the extrapolated estimated takes presented in Tables 4-8. Comparing the estimated total takes using different approaches demonstrates the degree to which stratification and the choice of effort variables affect the extrapolated estimates of total takes. The different estimates were not very consistent for any of the protected species examined in this report (Tables 4-8) which inspires little confidence in their accuracy. Additionally, precision of these estimates was not particularly good in most of cases, and never achieved the NMFS recommended goal of a 20-30% CV (NMFS, 2004). The CV of 0.37 for the pooled total takes in 2003 for loggerhead sea turtles was the closest to the desired level (Table 7c). The CV's for all other protected species were > 0.69 (Tables 4, 5, 6, and 8).

In all the estimates presented in Tables 4 through 8, either very sparse data were used or possibly unjustified poolings were undertaken to produce results. Sparse data sets were a problem for estimation of descriptive statistics (mean and variance) of the observed takes, particularly for bottlenose dolphins, leatherbacks, and smalltooth sawfish (1 or 2 observed takes depending upon pooling), as well as for loggerheads when the data were stratified. Rare events could be an argument for pooling across strata in the case of loggerheads, but this would not alleviate the problem for any of the other protected species. Sparse data are not likely to fit a critical assumption of the delta lognormal model (Pennington 1983) that the non-zero CPUE's are drawn from a lognormal distribution. One could argue that the sample could have been drawn from a larger population of captures within the fishery, and that this larger population was lognormally distributed. In any case, the extrapolated estimates based upon sparse data sets should not be assumed to be reasonable without potentially invoking large assumptions regarding unobserved events.

It is difficult to recommend using a specific effort variable; although it does seem reasonable that something beyond set would affect capture of protected resources. However, it may be equally reasonable that if a protected species was available to the gear, the catchability was 1.0, no matter what the total number of hooks in the set was. Other more important factors such as local habitat characteristics (temperature, location, etc), or characteristics of the target catch, may be the variable of interest. Only well controlled, fisheries independent, studies would be likely to be able to determine the importance of these other factors. Other measures of effort could be used, (such as trip), but other than further demonstrating the uncertainty associated with analysis of sparse data from surveys conduced for multiple purposes, there are no compelling reasons to explore any other measures of effort and the fundamental conclusion of this analysis (that sparse data is the primary problem) will not change.

The rarity of capture events was a serious problem for interpretation of extrapolated takes because estimates based on only one or a few captures are not confidence inspiring. Therefore, I would recommend excluding all estimates made with CV's =1.00 from management decisions. This problem has been wrestled with by NMFS before (see Appendix A, NMFS, 2004), and although they recommended using bycatch estimates with a CV of 20 or 30%, they also noted that in many rare event cases this might require 80-90% observer coverage.

Extrapolation that assumes capture is directly related to effort becomes particularly problematic when extrapolating across large spatial areas. Although a potential problem for all the protected species considered in this report, and part of the rational for stratifying analyses by region, it is particularly odd to extrapolate takes even within region for the smalltooth sawfish. The bulk of the smalltooth sawfish population is thought to reside in the region near the Everglades. For the single capture event in the SA in 2005 (Table 1, Figure 3) extrapolating to the entire SA region potentially introduces a gross positive bias to the estimate presented in Table 4, and one could argue that extrapolation should have been conducted over a much smaller region. Similarly for the Gulf of Mexico in 2003 (Table 1, Figure 1), although one may consider it good news that there are smalltooth sawfish almost as far north as Tampa Bay, extrapolation to the entire Gulf of Mexico may also introduce a huge positive bias to the stratified estimate of sawfish takes in Table 4. Extrapolated estimates for all of the protected species considered in this report may have similar issues. I have no recommendation of how to rectify this problem with the given data without making an arbitrary managerial decision about where and how to define the area of equal catchablity of sawfish, or other protected species, within the region of the shark bottom longline fishery operation. It may be necessary, if these decisions are to be based on expert "scientific" opinion, for biologists that study each specific species in the wild to be consulted by management to determine their likely range and habitat use.

I believe the choice of an analysis protocol, and therefore, estimated total takes, should be a management decision because there is no quantifiable justification for choosing one approach over another. Reducing the sparseness of the data within the observer program by first deciding on a stratification for each anticipated species of interest, then estimating sample sizes for a given target CV (30%, for example) by strata instead of across the pooled data may improve the confidence in extrapolated estimates in the future.

In short, there is no specific "best estimate" to be made based on the data. The best estimate to use would depend upon the specific question and context within which that estimate would be used. If I had to recommend one set of take estimates and associated analyses, my personal bias is towards analysis that follows study design. Therefore, I would say the "best" estimates in the report are the confidence limit ranges for the fully stratified (by area and season) catch estimates using hooks as the unit of effort, or the associated sums if annual estimates are desired. While there may be valid statistical arguments for pooling, for many species (like the smalltooth sawfish example above) there are important biological reasons not to pool across large spatial or temporal scales (such as year or season).

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Figure 1: Observed sets (n = 181) and takes of protected species for 2003. The southern most loggerhead capture event in the Atlantic represents 2 captures in a single set.

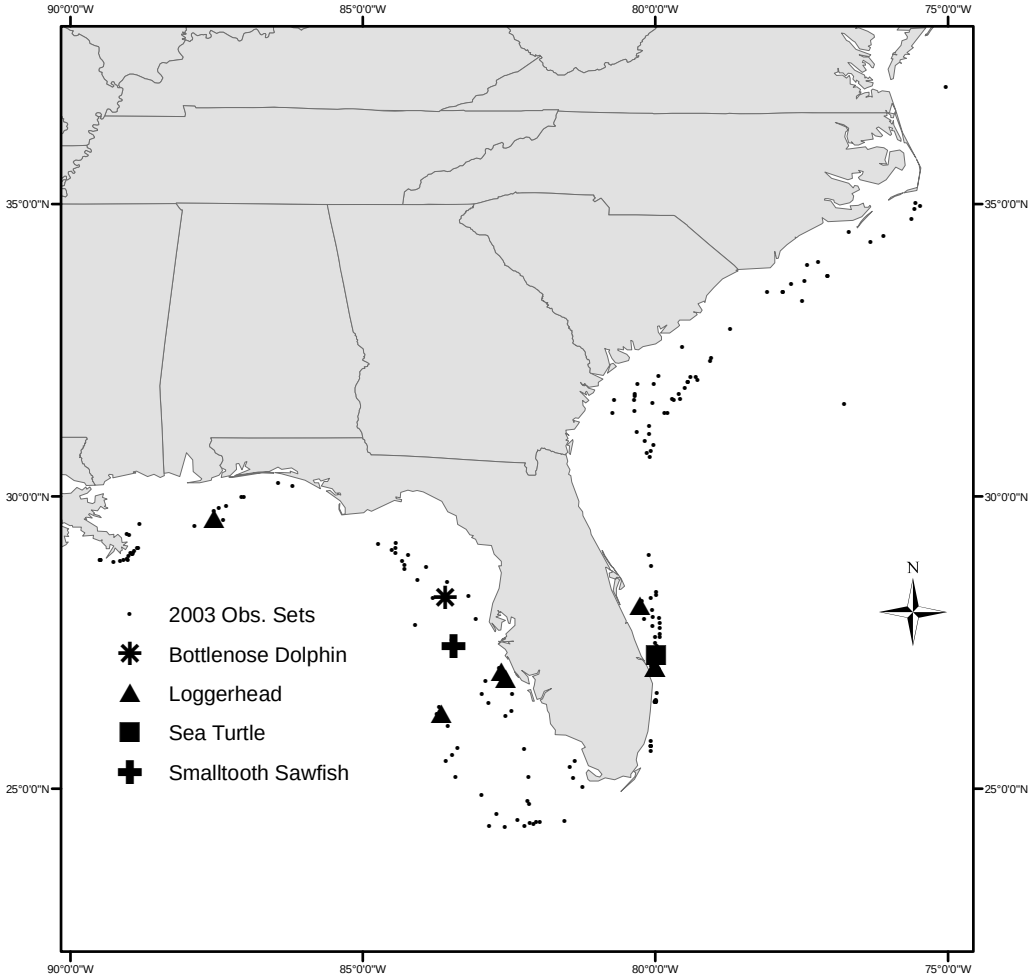

Figure 2: Observed sets (n = 124) and takes of protected species for 2004.

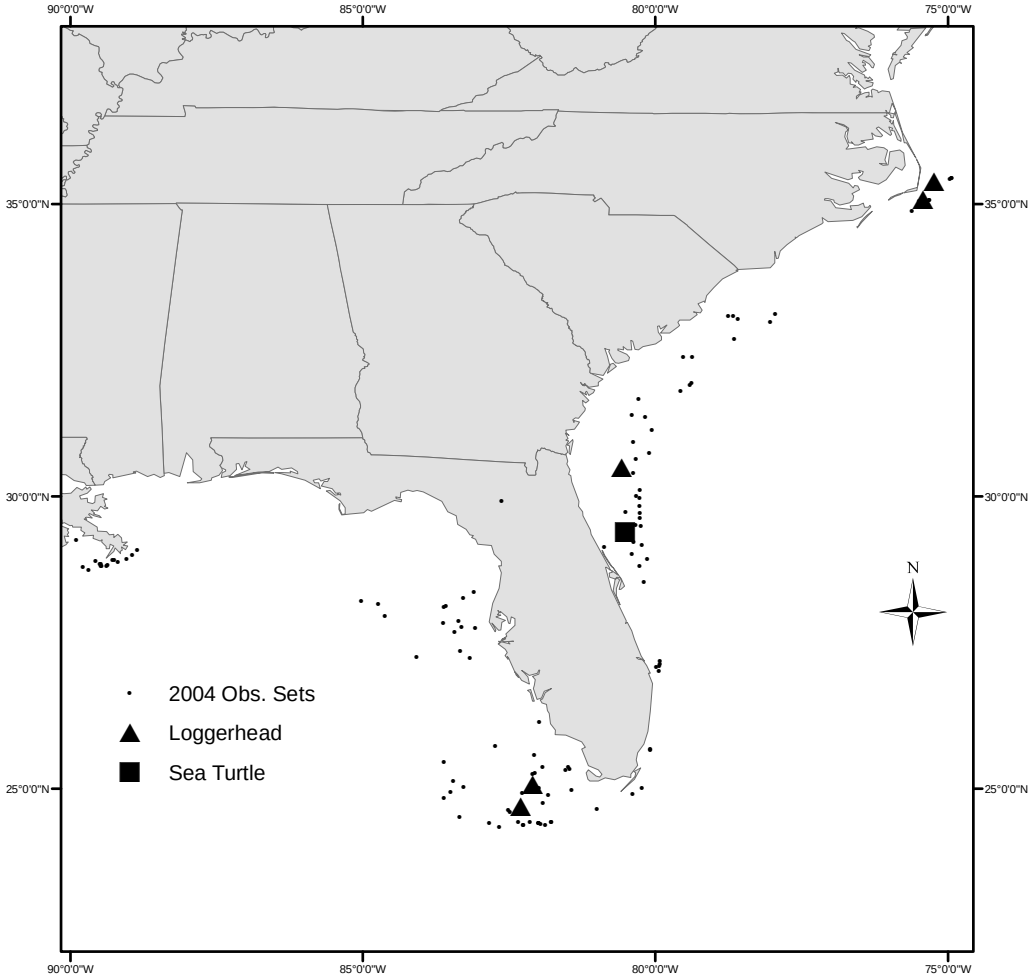

Figure 3: Observed sets (n = 126) and takes of protected species for 2005. The smalltooth sawfish capture event represents 2 captures in a single set.

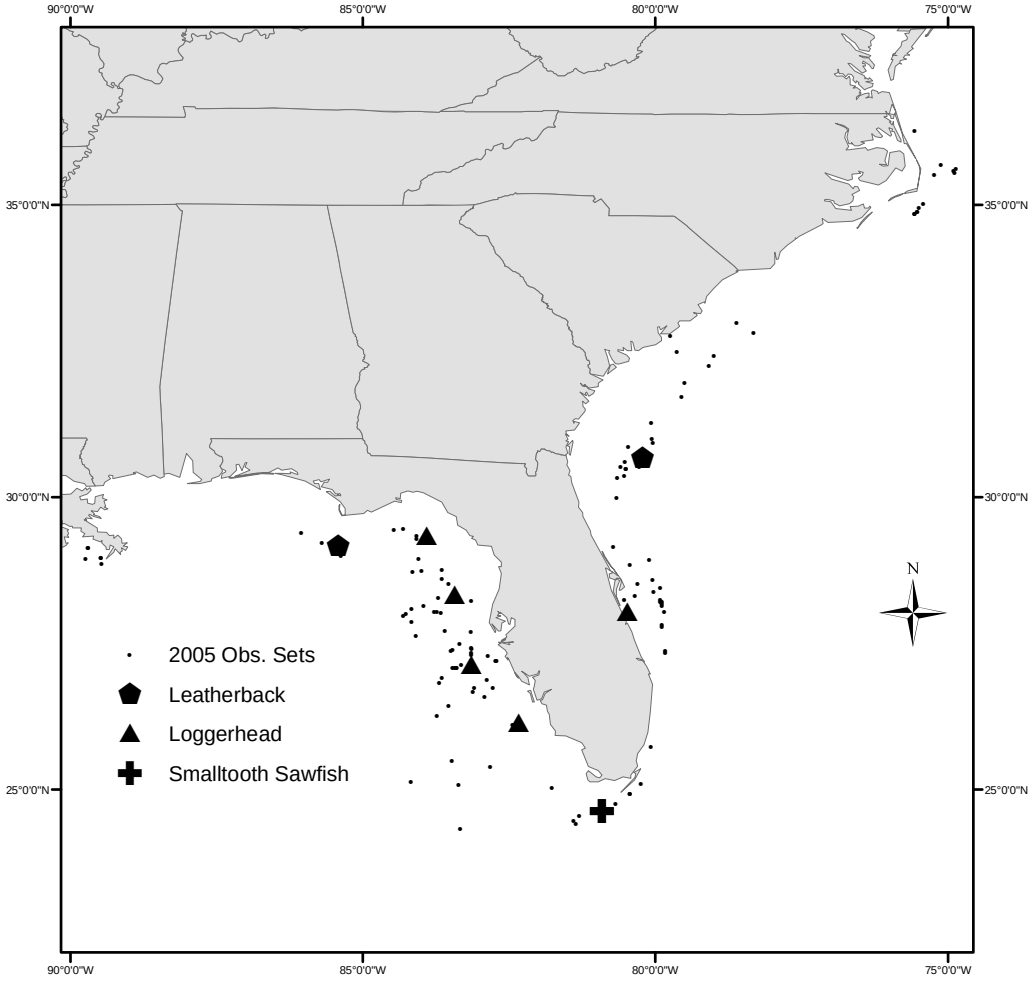

Table 1: Observed takes of protected species (loggerhead turtles, leatherback turtles, smalltooth sawfish, bottlenose dolphins, and unidentified turtles) by set. GOM = Gulf of Mexico, SA = "South Atlantic" (as defined for this fishery in Smith et al. 2006). The condition of the unidentified turtles was not recorded.

Year	Region	Season	Hooks	Species	Number	Condition
2003	GOM	1	355	Loggerhead	1	Alive
2003	GOM	1	250	Loggerhead	1	Alive
2003	GOM	2	641	Bottlenose Dolphin	1	Dead
2003	GOM	2	1054	Loggerhead	1	Alive
2003	GOM	2	279	Loggerhead	1	Alive
2003	GOM	2	399	Smalltooth Sawfish	1	Alive
2003	SA	1	761	Loggerhead	2	Alive
2003	SA	1	573	Sea Turtle	1	
2003	SA	2	278	Loggerhead	1	Dead
2004	GOM	1	1250	Loggerhead	1	Alive
2004	GOM	1	805	Loggerhead	1	Alive
2004	SA	1	280	Loggerhead	1	Dead
2004	SA	1	898	Loggerhead	1	Dead
2004	SA	1	850	Loggerhead	1	Alive
2004	SA	2	1011	Turtle	1	
2005	GOM	1	827	Leatherback	1	Alive
2005	GOM	1	466	Loggerhead	1	Alive
2005	GOM	2	450	Loggerhead	1	Dead
2005	GOM	2	317	Loggerhead	1	Dead
2005	GOM	2	317	Loggerhead	1	Alive
2005	SA	2	894	Leatherback	1	Dead
2005	SA	2	729	Loggerhead	1	Dead
2005	SA	2	985	Smalltooth Sawfish	2	Alive

Table 2: Combined reported effort in sets and hooks from the Southeast Fisheries Science Centers coastal and pelagic longline logbooks for fishing vessels listed in the Southeast Regional Offices permit database as having a directed shark permit for at least part of the season and year, that used bottom longline gear and either landed sharks, or targeted sharks by year, region, and season.

Year	Season	Gulf of Mexico	"South Atlantic"	Row Totals
		Sets		
2003	1	2792	869	3661
2003	2	2609	476	3085
2003	All	5401	1345	6746
2004	1	1641	510	2151
2004	2	1272	517	1789
2004	All	2913	1027	3940
2005	1	1241	300	1541
2005	2	1652	652	2304
2005	All	2893	952	3845
		Hooks		
2003	1	3147080	678566	3825646
2003	2	2889091	327080	3216171
2003	All	6036171	1005646	7041817
2004	1	1736820	411085	2147905
2004	2	1265210	387341	1652551
2004	All	3002030	798426	3800456
2005	1	1246220	212811	1459031
2005	2	1503194	470490	1973684
2005	All	2749414	683301	3432715

Table 3: Observed effort in sets and hooks for fishers with directed shark fishing permits by year, region, and season. All observations by University of Florida, except for season 2 of 2005 which was observed by the Southeast Fisheries Science Center (SEFSC).

Year	Season	Gulf of Mexico	"South Atlantic"	Row Totals
		Sets		
2003	1	37	67	104
2003	2	45	32	77
2003	All	82	99	181
2004	1	28	32	60
2004	2	42	22	64
2004	All	70	54	124
2005	1	21	13	34
2005	2 (SEFSC)	46	46	92
2005	All	67	59	126
		Hooks		
2003	1	17645	44419[1]	62064
2003	2	31401	13201	44602
2003	All	49046	57620	106666
2004	1	20992	27363[2]	48355
2004	2	25352	18983	44335
2004	All	46344	46346	92690
2005	1	13363	10312	23675
2005	2 (SEFSC)	20248	30017	50265
2005	All	33611	40329	73940

[1] approximate, five sets had missing values, missing values were replaced with the mean of the remaining values (mean = 663, sd = 606.3, range (54- 2385)).

[2] approximate, two sets had missing values, missing values were replaced with the mean of the remaining values (mean = 855, sd = 433.8, range (280 - 1800)).

Table 4. Estimated live takes of smalltooth sawfish for 2003 and 2005 in the shark bottom longline fishery. No takes of smalltooth sawfish were observed in 2004.

4a. Estimated live takes of smalltooth sawfish for 2005. All values in this table are based on 2 captures in a single set.

Area	Season	Alive Takes	Alive 95% CI	Alive CV
Analyzed by set				
SA	1	0	-	-
SA	2	28.3	7.8-94.8	0.69
GOM	1	0	-	-
GOM	2	0	-	-
Sum stratified		28.3	7.8-94.8	0.69
Pooled by area and season		61.0	16.7-215.4	0.70
Analyzed by hook				
SA	1	0	-	-
SA	2	20.8	4.1-106.2	1.00
GOM	1	0	-	-
GOM	2	0	-	-
Sum stratified		20.8	4.1-106.2	1.00
Pooled by area and season		55.3	10.8-282.9	1.00

4b. Estimated live takes of smalltooth sawfish for 2003. All values in this table are based on a single capture event.

Area	Season	Alive Takes	Alive 95% CI	Alive CV
Analyzed by set				
SA	1	0	-	-
SA	2	0	-	-
GOM	1	0	-	-
GOM	2	58.0	10.3-301.8	0.99
Sum stratified		58.0	10.3-301.8	0.99
Pooled by area and season		37.3	6.6-206.6	1.00
Analyzed by hook				
SA	1	0	-	-
SA	2	0	-	-
GOM	1	0	-	-
GOM	2	160.9	31.5-822.7	1.00
Sum stratified		160.9	31.5-822.7	1.00
Pooled by area and season		97.5	19.1-498.6	1.00

Table 5. Estimated dead takes of bottlenose dolphin for 2003 in the shark bottom longline fishery. No takes of bottlenose dolphin were observed in 2004 and 2005. All values in this table are based on a single capture event.

Area	Season	Dead Takes	Dead 95% CI	Dead CV
Analyzed by set				
SA	1	0	-	-
SA	2	0	-	-
GOM	1	0	-	-
GOM	2	58.0	10.3-301.8	0.99
Sum stratified		58.0	10.3-301.8	0.99
Pooled by area and season		37.3	6.6-206.6	0.99
Analyzed by hook				
SA	1	0	-	-
SA	2	0	-	-
GOM	1	0	-	-
GOM	2	100.2	19.6-512.1	1.00
Sum stratified		100.2	19.6-512.1	1.00
Pooled by area and season		60.7	11.9-310.3	1.00

Table 6. Estimated takes of unidentified sea turtles for 2003 and 2004 in the shark bottom longline fishery. No takes of unidentified sea turtles were observed in 2005. All estimates here are based on a single capture event.

6a. Estimated takes of unidentified sea turtles for 2004.

Area	Season	Total Takes	Total 95% CI	Total CV
Analyzed by set				
SA	1	0	-	-
SA	2	23.5	4.2-112.7	0.98
GOM	1	0	-	-
GOM	2	0	-	-
Sum stratified		23.5	4.2-112.7	0.98
Pooled by area and season		31.8	5.6-174.4	1.00
Analyzed by hook				
SA	1	0	-	-
SA	2	17.4	3.4-89.0	1.00
GOM	1	0	-	-
GOM	2	0	-	-
Sum stratified		17.4	3.4-89.0	1.00
Pooled by area and season		30.3	5.9-155.0	1.00

6b. Estimated takes of unidentified sea turtles for 2003.

Area	Season	Total Takes	Total 95% CI	Total CV
Analyzed by set				
SA	1	13.0	2.3-69.4	0.99
SA	2	0	-	-
GOM	1	0	-	-
GOM	2	0	-	-
Sum stratified		13.0	2.3-69.4	0.99
Pooled by area and season		37.3	6.6-206.6	1.00
Analyzed by hook				
SA	1	17.7	3.5-90.4	1.00
SA	2	0	-	-
GOM	1	0	-	-
GOM	2	0	-	-
Sum stratified		17.7	3.5-90.4	1.00
Pooled by area and season		67.9	13.3-347.2	1.00

Table 7: Estimated takes of loggerhead sea turtles for 2003, 2004, and 2005 in the shark bottom longline fishery. All estimates, except those in bold, were based on three or fewer observed capture events. Bolded estimates were based on 5 or more observed capture events.

7a. Estimated alive, dead and total takes of loggerheads in 2005.

Area	Season	Alive Takes	Alive 95% CI	Alive CV	Dead Takes	Dead 95% CI	Dead CV	Total Takes	Total 95% CI	Total CV
Analyzed by set										
SA	1	0	-	-	0	-	-	0	-	-
SA	2	0	-	-	14.2	2.5-73.9	0.99	14.2	2.5-73.9	0.99
GOM	1	59.1	10.5-281.3	0.97	0	-	-	59.1	10.5-281.3	0.98
GOM	2	35.9	6.4-187.3	0.99	71.8	19.8-240.1	0.69	107.7	37.1-289.1	0.56
Sum stratified		95.0	-[1]	-[1]	86.0	-[1]	-[1]	181.0	-[1]	-[1]
Pooled by area and season		61.0	16.8-215.4	0.70	91.5	31.3-260.2	0.57	**152.6**	**65.6-344.3**	**0.44**
Analyzed by hook										
SA	1	0	-	-	0	-	-	0	-	-
SA	2	0	-	-	14.0	2.7-71.7	1.00	14.0	2.7-71.7	1.00
GOM	1	127.3	24.9-651.3	1.00	0	-	-	127.3	24.9-651.1	1.00
GOM	2	103.1	20.2-527.1	1.00	175.7	50.2-614.7	0.71	278.9	98.2-792.0	0.57
Sum stratified		230.4	64.9-818.6	0.72	189.7	63.9-563.6	0.60	420.3	174.1-1,015.0	0.43
Pooled by area and season		144.4	40.9-510.4	0.72	184.1	61.6-549.7	0.60	**329.1**	**139.2-778.0**	**0.46**

[1] not estimated

7b. Estimated alive, dead and total takes of loggerheads in 2004.

Area	Season	Alive Takes	Alive 95% CI	Alive CV	Dead Takes	Dead 95% CI	Dead CV	Total Takes	Total 95% CI	Total CV
Analyzed by set										
SA	1	15.9	2.8-80.3	0.98	31.9	8.8-102.8	0.68	47.8	16.5-123.5	0.55
SA	2	0	-	-	0	-	-	0	-	-
GOM	1	117.2	32.5-371.6	0.68	0	-	-	117.2	32.5-371.6	0.68
GOM	2	0	-	-	0	-	-	0	-	-
Sum stratified		133.2	-[1]	-[1]	31.9	8.8-102.8	0.68	165.0	-[1]	-[1]
Pooled by area and season		95.3	32.6-270.8	0.57	63.5	17.5-224.2	0.70	**158.9**	**68.3-358.3**	**0.44**
Analyzed by hook										
SA	1	15.1	3.0-77.3	1.00	60.2	15.3-236.0	0.79	74.1	23.7-231.3	0.63
SA	2	0	-	-	0	-	-	0	-	-
GOM	1	126.7	36.2-443.9	0.71	0	-	-	126.7	36.2-443.9	0.71
GOM	2	0	-	-	0	-	-	0	-	-
Sum stratified		141.8	49.4-407.1	0.60	60.2	15.3-236.0	0.79	200.8	80.2-502.8	0.50
Pooled by area and season		98.7	34.2-285.3	0.58	143.6	36.3-567.3	0.79	**236.3**	**94.6-590.5**	**0.49**

[1] not estimated

7c. Estimated alive, dead and total takes of loggerheads in 2003.

Area	Season	Alive Takes	Alive 95% CI	Alive CV	Dead Takes	Dead 95% CI	Dead CV	Total Takes	Total 95% CI	Total CV
Analyzed by set										
SA	1	25.9	7.1-89.0	0.70	0	-	-	25.9	7.1-89.0	0.70
SA	2	0	-	-	14.9	2.6-74.9	0.98	14.9	2.6-74.9	0.98
GOM	1	150.9	41.7-494.3	0.69	0	-	-	150.9	41.7-494.3	0.69
GOM	2	116.0	32.0-386.9	0.69	0	-	-	116.0	32.0-386.9	0.69
Sum stratified		292.8	-[1]	-[1]	14.9	2.6-74.9	0.98	307.7	-[1]	-[1]
Pooled by area and season		**223.6**	**103.1-475.1**	**0.40**	37.3	6.6-206.6	1.00	**260.9**	**127.2-523.9**	**0.37**
Analyzed by hook										
SA	1	26.6	5.2-136.1	1.00	0	-	-	26.6	5.2-136.1	1.00
SA	2	0	-	-	36.8	7.2-188.0	1.00	36.8	7.2-188.0	1.00
GOM	1	579.8	166.2-2,023.1	0.71	0	-	-	579.8	166.2-2,023.1	0.71
GOM	2	291.0	72.0-1,176.1	0.81	0	-	-	291.0	72.0-1,176.1	0.81
Sum stratified		897.5	361.3-2,229.3	0.49	36.8	7.2-188.0	1.00	934.2	405.4-2,152.7	0.45
Pooled by area and season		**556.1**	**221.5-1,396.1**	**0.50**	139.9	27.4-715.6	1.00	**699.8**	**302.2-1,620.1**	**0.45**

[1] not estimated

Table 8: Estimated takes of leatherback sea turtles for 2005, in the shark bottom longline fishery. No takes of leatherback sea turtles were observed in 2003 or 2004. All estimates, except pooled total takes, were based on a single observed capture event and pooled total takes were based on two observed events.

Area	Season	Alive Takes	Alive 95% CI	Alive CV	Dead Takes	Dead 95% CI	Dead CV	Total Takes	Total 95% CI	Total CV
Analyzed by set										
SA	1	0	-	-	0	-	-	0	-	-
SA	2	0	-	-	14.2	2.5-73.9	0.99	14.2	2.5-73.9	0.99
GOM	1	59.1	10.5-281.3	0.98	0	-	-	59.1	10.5-281.3	0.98
GOM	2	0	-	-	0	-	-	0	-	-
Sum stratified		59.1	10.5-281.3	0.98	14.2	2.5-73.9	0.99	73.3	-[1]	-[1]
Pooled by area and season		30.5	5.4-167.6	1.00	30.5	5.4-167.6	1.00	61.0	16.8-215.4	0.70
Analyzed by hook										
SA	1	0	-	-	0	-	-	0	-	-
SA	2	0	-	-	11.4	2.2-58.5	1.0	11.4	2.2-58.5	1.00
GOM	1	71.8	14.0-366.9	1.0	0	-	-	71.8	14.0-366.9	1.00
GOM	2	0	-	-	0	-	-	0	-	-
Sum stratified		71.8	14.0-366.9	1.0	11.4	2.2-58.5	1.0	83.2	22.1-313.9	0.76
Pooled by area and season		32.9	6.4-168.4	1.0	30.5	6.0-155.8	1.0	63.4	18.3-220.2	0.70

[1] not estimated

Appendix A: NMFS required supplementary sea turtle information for this report. Information for 2005 only, table is split and rows are identified by record number.

Record Number	Month C	Day C	Quarter	Experiment	Species	Area	Trip #	Haul #	Hook Type	Offset (degrees)	Bait	Bait Size	Release Condition	Hook Location
1	9	13	3	No	Loggerhead	GOM	WAH003	1	unknown	unknown	unknown	unknown	Fresh dead	beak (internal)/mouth/tongue/glottis
2	7	13	3	No	Loggerhead	GOM	WAH002	1	C- 16/0	10	unknown	unknown	Fresh dead	not hooked
3	9	15	3	No	Leatherback	SAB	BTW008	1	C- 20/0	0	unknown	unknown	Fresh dead	not hooked
4	10	16	4	No	Loggerhead	GOM	WAH004	3	J- 12/0	0	cut tunny	4" x 7"	Fresh dead	beak internal
5	10	20	4	No	Loggerhead	GOM	WAH005	4	J- 12/0	0	cut tunny	4" x 6"	Alive, injured	front flipper/shoulder/armpit
6	2	17	1	No	Loggerhead	GOM	020501	307	J-"3inch"	unknown	cut tunny	unknown	alive, unknown	not hooked
7	2	16	1	No	Leatherback	GOM	020501	506	J-12/0	unknown	eel, skate	unknown	unknown	not known if hooked

Record Number	Jaw Location	Hook Visible?	Hook Removed?	Entangled Capture?	Entangled Release?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
1	upper	na	yes	no	no	0.0		78	
2	na	na	na	yes	no	0.0	4.5		
3	na	na	na	yes	no	0.0	4.9		
4	upper	na	no	no	no	1.0	4.5		
5	na	na	no	no	no	0.5	5.0		
6	na	na	na	yes	no	0.0	3.0		
7	unk	unk	no	unk	unk	6.0	5.0		